A Twenty-Six Year History of Wood Stork Nesting in South Carolina

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Abstract.—Since the first documented successful nesting of Wood Storks (*Mycteria americana*) in South Carolina in 1981, a total of 16,642 nesting attempts have been recorded. During the past 26 years, annual nesting has increased from eleven to a high of 2,057 nests in 2004. Storks have used 27 different colony sites, however, five sites have supported 76.3% of all nesting attempts. Mean colony size was 118 nests (range 1-547). Colony turnover rate was 0.19 overall based on annual calculations. However, 95.6% of colonies with more than 100 nests in one year were active the following year (N = 68). Only three of 27 sites are in public ownership and 21 sites are in wetlands altered or maintained by man. Production of young has been high each year (x bar = 2.08 young per successful nest) and abandonment of active colonies has been rare. This may result from the availability of varied habitats used by foraging storks. Nesting storks use palustrine habitats associated with rivers, inter-tidal wetlands, isolated wetlands and marsh impoundments. The variety of habitats used, combined with the topography of our coastal plain, provide adequate foraging habitat under a wide range of rainfall conditions.

Key words.—Fledgling, nesting, South Carolina, Wood Stork.

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The first Wood Stork (*Mycteria americana*) reference for South Carolina occurred in 1809. Stephen Elliott presented a "wood ibis" specimen to Alexander Wilson as he traveled through Beaufort, South Carolina on his way to Savannah (Sanders and Anderson 2000). This specimen was used in the painting of the Wood Stork for American Ornithology (Wilson 1814). Arthur T. Wayne reported young storks in the thousands feeding in Copahee Sound near his home just north of Charleston from June through October and wrote that this species was more often seen in flocks of thousands than in smaller groups. He considered the stork as a permanent resident as a few remained through the winter (Wayne 1910). Sprunt and Chamberlain (1949) reported storks as permanent coastal residents and common in summer. They also report that there is a distinct move from fresh water lagoons to the salt marshes in July. Hamel (1976) summarized reports of stork nesting activities observed in the State but did not document eggs or chicks in any of the historical reports.

More recently, Murphy reported stork nest numbers from 1981-1994. During this time, the annual nesting population expanded from eleven to 712 nests. The number of colony sites increased from one to seven with new colonies now extending up the coast to the Santee River. It was also estimated that South Carolina wetlands could support at least 2,400 nesting pairs (Murphy 1995).

There has been extensive work on habitat use and movements of storks primarily in Georgia (Depkin *et al.* 1992; Coulter and Bryan 1993; Coulter and Bryan 1995; Gaines *et al.* 1998; Gaines *et al.* 2000). This work documented differences in the ecology of Wood Storks nesting north of Florida. Storks feed in small groups, among low densities of larger prey, and they usually breed successfully (Coulter *et al.* 1999). Mitchell delineated habitat types in one and five-mile radii around major nesting colonies in South Carolina. She documented that more than 50% was upland habitat and that amount of palustrine wetlands influenced colony size. Although other factors may also contribute to the variability in the carrying capacity of nesting sites, the greater the acreage of palustrine wetlands, the greater the size of the colony. Wetland habitat was dominated by palustrine wetlands and was distributed linearly along river corridors (Mitchell 2002).

METHODS

Aerial Surveys

Surveys of nesting sites were conducted in a high-wing, single engine aircraft at altitudes under 150 m. All sites where colonial water bird nesting was recorded in

any of the five previous years were surveyed. This included all sites previously used by storks for nesting and where non-nesting storks were seen during the previous nesting season. In addition, areas of suitable habitat were searched while flying between sites, as well as areas where storks were seen during the flight or where the public recently reported storks. At large or mixed species colonies an aerial estimate of nesting was made, while a direct count of nests at small colonies was conducted. Finally, it was noted if the colony appeared larger, smaller or the same size as the previous year. The distribution of stork nests within a colony site was mapped and photographs taken. At new sites, a GPS location was recorded and an access route noted from the nearest landmark.

Ground Surveys

Counts were made by wading, canoeing or using "float shoes" to move through colonies. Float shoes are homemade flotation devices constructed from a reinforced block of Styrofoam attached to each foot. With the aid of push poles, they allow observers to "walk" over water too deep to wade and through heavy vegetation where canoes are impractical. Nests were censused by counting all stork nests present in any tree between observers. The number of observers and the distance between observers varied with colony size and nest distribution. Census dates were scheduled based on periodic visits to colonies that were easily accessed. Counts were conducted after the first chicks hatched, but well prior to first fledging during the second and third weeks in May.

A second ground census was conducted to estimate chick production just prior to fledging and generally before chicks could move between nests. Nests were recorded as having zero, one, two, three or four chicks. A category of "unknown" was used for nests where chicks could be heard or partially seen, but where no reliable count could be obtained. Chicks per successful nest was calculated by dividing the total number of chicks counted by total number of successful nests documented at each colony site and for all colonies combined.

Colony Turnover Rates

Colony turnover rates were calculated as the proportion of colonies that were different in two consecutive years, using the formula of Buckley and Buckley (2000). High colony turnover rates suggest that purchase of colony sites would not be an effective management option.

RESULTS

In the spring of 1981, the first documented successful Wood Stork nesting in the state was located. Fourteen large chicks were counted in eleven nests during a ground census. Previous nesting activity such as stick carrying and courtship were reported by Wayne in 1885 (Wayne 1910), by Sprunt in 1928 (Alexander Sprunt, Jr., field notes *fide* Alexander Sprunt IV) and by Hamel in 1976 (Hamel 1977). In none of these cases were there reports of eggs or chicks, thus we conclude that 1981 was the first successful nesting documented for South Carolina. Successful nesting has been documented during every year since. The first four years of nesting remained minimal with no more than 22 nests in any year. Between 1985 and 1993, stork nesting increased steadily to 806 nests in three colonies. All colonies were in the southern coast in palustrine habitat associated with the St. Helena Sound drainage.

In 1994, the number of nests declined slightly from the previous year but new colonies formed near Charleston and Georgetown. This extended the nesting range 75 km to the north. Between 1994 and 2006, the number of active colonies increased to 13 and the number of nests increased to 2010. Annual nesting attempts have increased linearly ($r^2 = 0.86$, $p < 0.001$). During this period, colonies formed along the entire coast and most river drainages now support stork nesting (Figure 1). During 2006, there were eleven colonies that had more than 100 nesting pairs each, with the two remaining colonies supporting only 45 nests total.

In 26 seasons, there have been 16,642 nesting attempts by Wood Storks in South Carolina. The highest number occurred in 2004 with 2,057 nests. Mean colony size was 118 nests (range one to 547). Five of 27 colonies have supported 76.3% of all nesting attempts and these five colonies have remained active 95.8% of the time. There were twelve colonies that never supported more than 50 nests in any one year. These colonies

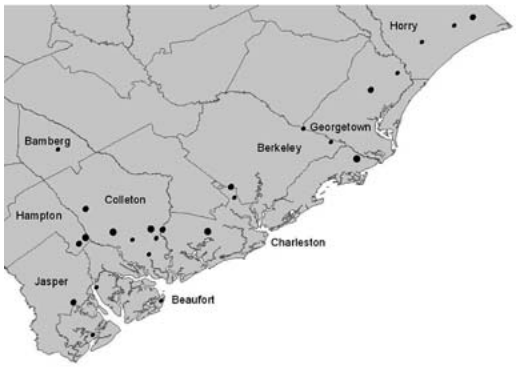

Figure 1. Map of South Carolina indicating locations of Wood Stork colonies and river drainages.

supported only 1.52% of nesting attempts and were not active in 2006. Overall, 84.4% of stork colonies remained active the following year. Colony turnover rate was 0.19 overall based on annual calculations (Buckley and Buckley 2000). However, 95.6% of colonies with more than 100 nests in one year were active the following year (N = 68).

Only three of 27 sites are in public ownership and 21 sites are in wetlands altered or maintained by man. It's believed that annual nest numbers for the state are nearly complete because 21 nesting sites were monitored as colonial waterbird nesting sites the year prior to stork use. The remaining six were small or were reported to us by the landowner as the first year of use by storks.

The overall chick production was 2.08 young per successful nest and remained above 1.5 for each year since 1985 when standardized surveys began (range 1.72-2.75). The state's stork nesting has gone from fledging tens of young to hundreds of young and most recently thousands of young per year.

Observations of foraging storks suggest that palustrine wetlands, intertidal creeks, isolated wetlands and managed marsh impoundments are all used by foraging storks in South Carolina.

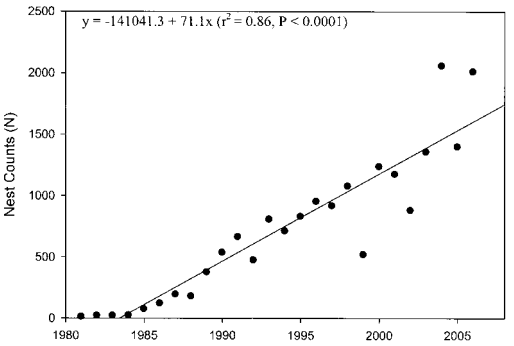

Figure 2. Linear regression of annual Wood Stork nest counts from 1980-2006.

DISCUSSION

Prior to 1981, storks were abundant from June through October as post-nesting or non-nesting storks moved north but were uncommon during winter and spring. While common during summer in the 1970's and 80's, they were not seen in the thousands reported by Wayne in the early 1900's. From 1981-1984, annual nesting continued at a low level and did not exceed 22 nests per year. From 1985 to the present, stork nesting has increased linearly (Figure 2). This linear fit is likely a result of monitoring during the growth phase of a sigmoid curve. As the nesting population reaches carrying capacity, stork nesting will likely better fit a sigmoid growth curve. Several years with lower than expected annual nesting (1999 and 2002) were a result of early season failures resulting from bad weather as documented for Georgia colonies (Coulter and Bryan 1995). Cold, wet or windy weather can result in nest failures prior to ground census.

Wood stork nesting in South Carolina has increased from eleven nests at one colony site to 2010 nests at 13 sites in 26 years. The geographic expansion of nesting colonies has not been regular. After 13 years of nesting on the southern coast, storks formed new colonies near Charleston and Georgetown and increased from three to seven colonies with no increase in the number of nesting pairs. By 1997, colonies had formed up the coast to near the North Carolina state line. Since that time, significant colonies have formed in additional drainages and we currently have eleven colonies with more than 100 nests per year. Colonies tend to expand rapidly and then stabilize at a size characteristic of that site. Movement of birds from large colonies to new nearby sites is generally associated with a lack of open water in the established colony. During the drought years from 1999-2002, several large colonies moved from sites with low water and dense floating aquatic vegetation to nearby sites with open water.

Much of the early increases in nesting were likely from non-natal birds, as chick production from South Carolina colonies would not explain the increases. In recent years, large numbers of chicks fledged in the state could contribute to increased nesting, but the actual source of nesting storks is unknown. Over the past 22 years, chick production in South Carolina colonies has averaged

2.08 young per successful nest (range 1.72-2.73). Besides early season affects of weather, large-scale nest abandonment has not been observed.

The annual consistency of chick production is thought to be related to the variety of habitats available to storks and the relatively high topographic relief of the palustrine wetlands associated with coastal rivers. Under a variety of rainfall conditions, shallow water is available in the forested wetlands associated with these wide river corridors. In addition, with a high tidal amplitude and wide expanses of marsh, inter tidal creek habitat is available within two hours of low tide in brackish and salt marshes. As the water recedes from the marsh bed, prey is concentrated in potholes and creeks that represent 10% of the area occupied at high tide. Storks can forage during both the diurnal and nocturnal low tides. Isolated wetlands such as ponds, ditches and Carolina bays provide foraging opportunities particularly when high rainfall is followed by drought. However, extended drought causes much of this habitat type to dry out completely, making it unusable by storks.

Managed wetlands provide temporary high-density foraging habitat during seasonal drawdowns. There are 28,491 ha of coastal tidal marsh impoundments in South Carolina. These impoundments are maintained and managed primarily for waterfowl, but when the water level is lowered, fish are forced off the marsh bed and concentrate in the deeper canals that generally surround the impoundment. We work with landowners to maximize stork use of impoundments. We encourage a staggered series of drawdowns instead of lowering all the impoundments at once. We also encourage drawdowns in late June and early July to provide high quality habitat during late chick development and foraging opportunities for recently fledged chicks. Impoundments near nesting colonies are of particular importance. As soon as the water is below the marsh bed, large numbers of storks, frequently in the 100s, arrive at the site and forage for up to one week along with a variety of other waterbirds. One or several drawdowns each spring or summer are normal management actions taken to encourage food plants for waterfowl, but additional drawdowns and reflooding on new and full moon tides also enhance the area for a variety of waterbirds. During periods when impoundments are flooded deep, there is little foraging by storks.

Wood Stork nest numbers appear to be stabilizing at around 2,000 with most major river drainages supporting nesting. The few larger colonies are important because they produce the majority of chicks and have high site fidelity. Most are in private ownership. With 89% of all nesting sites on private lands, management in partnership with private landowners is essential to maintaining successful nesting colonies. Acquisition of large stable nesting sites that have high site fidelity should be a priority. Systematic monitoring of nesting should continue in coordination with the Wood Stork Working Group along with documenting foraging habitats used in this the northern portion of the storks range.

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